Claims

What is claimed is:

Claim 1.     A method of horizontally structured CAD/CAM manufacturing for concurrent product and process design, comprising:

selecting a blank for machining into an actual part establishing a coordinate system;

5          creating a master product and process concurrent model comprising:

a virtual blank corresponding to said blank;

a manufacturing feature;

virtual machining of said manufacturing feature into said

10   virtual blank;

said manufacturing feature exhibiting an associative relationship with said coordinate system;

generating a product drawing of said actual part; and

generating machining instructions to create said actual

15   part by machining said manufacturing feature into said blank.

Claim 2.     The method of Claim 1 wherein said associative relationship is a parent/child relationship.

Claim 3.     The method of Claim 1 further including said manufacturing feature exhibiting an associative relationship with another said manufacturing feature.

Claim 4.     The method of Claim 3 wherein said associative relationship is a parent/child relationship.

Claim 5.     The method of Claim 1 wherein said virtual blank exhibits an associative relationship with another said manufacturing feature.

Claim 6.     The method of Claim 5 wherein said associative relationship is a parent/child relationship.

Claim 7.    The method of Claim 1 wherein said virtual blank exhibits an associative relationship with said coordinate system.

Claim 8.    The method of Claim 7 wherein said associative relationship is a parent/child relationship.

Claim 9.    The method of Claim 1 further comprising creating extracts from said master product and process model.

Claim 10.    The method of Claim 9 wherein said extracts comprise replicated models of said master product and process model at various operations of said manufacturing.

Claim 11.    The method of Claim 9 wherein said extracts are used to generate manufacturing process sheets.

Claim 12.    The method of Claim 1 wherein said virtual blank is positioned and oriented relative to said coordinate system.

Claim 13.    The method of Claim 12 wherein said virtual blank is generated as a three dimensional parametric solid model from a reference set geometry.

Claim 14.    The method of Claim 13 wherein said reference set geometry is defined by dimensional characteristics of a modeled part.

Claim 15.    The method of Claim 1 wherein establishing said coordinate system comprises one or more datum planes.

Claim 16.    The method of Claim 1 wherein said coordinate system comprises:

creating a first datum plane positioned and oriented relative to a reference;

creating a second datum plane positioned and oriented relative to said reference; and

creating a third datum plane positioned and oriented relative to said reference.

Claim 17.    The method of Claim 16 wherein said first datum plane, said second datum plane, and said third datum plane are orthogonal.

Claim 18.    The method of Claim 1 wherein said manufacturing instructions comprise process sheets.

Claim 19.    The method of Claim 1 wherein said product drawings include an associative relationship with said master product and process concurrent model.

Claim 20.    The method of Claim 19 wherein said associative relationship is a parent/child relationship.

Claim 21.    The method of Claim 1 further comprising said master product and process concurrent model links to a process planning system.

Claim 22.    The method of Claim 21 wherein said process planning system comprises automated creation of a manufacturing process plan.

Claim 23.    A manufactured part created by a method of horizontally structured CAD/CAM manufacturing for concurrent product and process design, comprising:

a blank for machining into an actual part a coordinate system;

5          a master product and process concurrent model comprising:

a virtual blank corresponding to said blank;

a manufacturing feature;

virtual machining of said manufacturing feature into said virtual blank;

10          said manufacturing feature exhibiting an associative relationship with said coordinate system;

a product drawing of said actual part; and

said actual part created by machining said manufacturing feature into said blank in accordance with a machining instruction.

Claim 24.    The manufactured part of Claim 23 wherein said associative relationship is a parent/child relationship.

Claim 25.    The manufactured part of Claim 23 further including said manufacturing feature exhibiting an associative relationship with another said manufacturing feature.

Claim 26.    The manufactured part of Claim 25 wherein said associative relationship is a parent/child relationship.

Claim 27.    The manufactured part of Claim 23 wherein said virtual blank exhibits an associative relationship with another said manufacturing feature.

Claim 28.    The manufactured part of Claim 27 wherein said associative relationship is a parent/child relationship.

Claim 29.    The manufactured part of Claim 23 wherein said virtual blank exhibits an associative relationship with said coordinate system.

Claim 30.     The manufactured part of Claim 29 wherein said associative relationship is a parent/child relationship.

Claim 31.     The manufactured part of Claim 23 further comprising extracts created from said master product and process concurrent model.

Claim 32.     The manufactured part of Claim 31 wherein said extracts comprise replicated models of said master product and process model at various operations of said manufacturing.

Claim 33.     The manufactured part of Claim 32 wherein said extracts are used to generate manufacturing process sheets.

Claim 34.     The manufactured part of Claim 23 wherein said virtual blank is positioned and oriented relative to said coordinate system.

Claim 35.     The manufactured part of Claim 34 wherein said virtual blank is generated as a three dimensional parametric solid model from a reference set geometry.

Claim 36.     The manufactured part of Claim 35 wherein said reference set geometry is defined by dimensional characteristics of a modeled part.

Claim 37.     The manufactured part of Claim 23 wherein said coordinate system comprises one or more datum planes.

Claim38. The manufactured part of Claim 23 wherein said coordinate system comprises:

a first datum plane positioned and oriented relative to a reference;

a second datum plane positioned and oriented relative to said reference; and

a third datum plane positioned and oriented relative to said reference.

Claim 39. The manufactured part of Claim 38 wherein said first datum plane, said second datum plane, and said third datum plane are orthogonal.

Claim 40. The manufactured part of Claim 23 wherein said manufacturing instructions comprise process sheets.

Claim 41. The manufactured part of Claim 23 wherein said product drawings include an associative relationship with said master product and process concurrent model.

Claim 42. The manufactured part of Claim 41 wherein said associative relationship is a parent/child relationship.

Claim 43. The manufactured part of Claim 23 further comprising said master product and process concurrent model links to a process planning system.

Claim 44. The manufactured part of Claim 43 wherein said process planning system comprises automated creation of a manufacturing process plan.

Claim 45.     A storage medium encoded with a machine-readable computer program code for horizontally structured CAD/CAM manufacturing for concurrent product and process design, said storage medium including instructions for causing a computer to implement a method

5     comprising:

selecting a blank for machining into an actual part establishing a coordinate system;

creating a master product and process concurrent model comprising:

10                    a virtual blank corresponding to said blank;

a manufacturing feature;

virtual machining of said manufacturing feature into said virtual blank;

said manufacturing feature exhibiting an associative

15     relationship with said coordinate system;

generating a product drawing of said actual part; and

generating machining instructions to create said actual part by machining said manufacturing feature into said blank.


Claim 46.     The storage medium of Claim 45 wherein said associative relationship is a parent/child relationship.


Claim 47.     The storage medium of Claim 45 further including said manufacturing feature exhibiting an associative relationship with another said manufacturing feature.


Claim 48.     The storage medium of Claim 47 wherein said associative relationship is a parent/child relationship.


Claim 49.     The storage medium of Claim 45 wherein said virtual blank exhibits an associative relationship with another said manufacturing feature.

Claim 50.    The storage medium of Claim 49 wherein said associative relationship is a parent/child relationship.

Claim 51.    The storage medium of Claim 45 wherein said virtual blank exhibits an associative relationship with said coordinate system.

Claim 52.    The storage medium of Claim 51 wherein said associative relationship is a parent/child relationship.

Claim 53.    The storage medium of Claim 45 further comprising creating extracts from said master product and process concurrent model.

Claim 54.    The storage medium of Claim 53 wherein said extracts comprise replicated models of said master product and process concurrent model at various operations of said manufacturing.

Claim 55.    The storage medium of Claim 53 wherein said extracts are used to generate manufacturing process sheets.

Claim 56.    The storage medium of Claim 45 wherein said virtual blank is positioned and oriented relative to said coordinate system.

Claim 57.    The storage medium of Claim 56 wherein said virtual blank is generated as a three dimensional parametric solid model from a reference set geometry.

Claim 58.    The storage medium of Claim 57 wherein said reference set geometry is defined by dimensional characteristics of a modeled part.

Claim 59.    The storage medium of Claim 45 wherein establishing said coordinate system comprises one or more datum planes.

Claim 60.    The storage medium of Claim 45 wherein said coordinate system comprises:

creating a first datum plane positioned and oriented relative to a reference;

creating a second datum plane positioned and oriented relative to said reference; and

creating a third datum plane positioned and oriented relative to said reference.

Claim 61.    The storage medium of Claim 60 wherein said first datum plane, said second datum plane, and said third datum plane are orthogonal.

Claim 62.    The storage medium of Claim 45 wherein said manufacturing instructions comprise process sheets.

Claim 63.    The storage medium of Claim 45 wherein said product drawings include an associative relationship with said master product and process concurrent model.

Claim 64.    The storage medium of Claim 63 wherein said associative relationship is a parent/child relationship.

Claim 65.    The storage medium of Claim 45 further comprising said master product and process model links to a process planning system.

Claim 66.    The storage medium of Claim 65 wherein said process planning system comprises automated creation of a manufacturing process plan.

Claim 67.    A computer data signal for horizontally structured CAD/CAM manufacturing for concurrent product and process design, said computer data signal comprising code configured to cause a processor to implement a method comprising:

5          selecting a blank for machining into an actual part establishing a coordinate system;

creating a master product and process concurrent model comprising:

a virtual blank corresponding to said blank;

10          a manufacturing feature;

virtual machining of said manufacturing feature into said virtual blank;

said manufacturing feature exhibiting an associative relationship with said coordinate system;

15          generating a product drawing of said actual part; and

generating machining instructions to create said actual part by machining said manufacturing feature into said blank.

Claim 68.    The computer data signal of Claim 67 wherein said associative relationship is a parent/child relationship.

Claim 69.    The computer data signal of Claim 67 further including said manufacturing feature exhibiting an associative relationship with another said manufacturing feature.

Claim 70.    The computer data signal of Claim 69 wherein said associative relationship is a parent/child relationship.

Claim 71.    The computer data signal of Claim 67 wherein said virtual blank exhibits an associative relationship with another said manufacturing feature.

Claim 72.    The computer data signal of Claim 71 wherein said associative relationship is a parent/child relationship.

Claim 73.    The computer data signal of Claim 67 wherein said virtual blank exhibits an associative relationship with said coordinate system.

Claim 74.    The computer data signal of Claim 73 wherein said associative relationship is a parent/child relationship.

Claim 75.    The computer data signal of Claim 67 further comprising creating extracts from said master product and process concurrent model.

Claim 76.    The computer data signal of Claim 75 wherein said extracts comprise replicated models of said master product and process concurrent model at various operations of said manufacturing.

Claim 77.    The computer data signal of Claim 75 wherein said extracts are used to generate manufacturing process sheets.

Claim 78.    The computer data signal of Claim 67 wherein said virtual blank is positioned and oriented relative to said coordinate system.

Claim 79.    The computer data signal of Claim 78 wherein said virtual blank is generated as a three dimensional parametric solid model from a reference set geometry.

Claim 80.    The computer data signal of Claim 79 wherein said reference set geometry is defined by dimensional characteristics of a modeled part.

Claim 81.    The computer data signal of Claim 67 wherein establishing said coordinate system comprises one or more datum planes.

Claim 82.     The computer data signal of Claim 67 wherein said coordinate system comprises:

creating a first datum plane positioned and oriented relative to a reference;

creating a second datum plane positioned and oriented relative to said reference; and

creating a third datum plane positioned and oriented relative to said reference.

Claim 83.     The computer data signal of Claim 82 wherein said first datum plane, said second datum plane, and said third datum plane are orthogonal.

Claim 84.     The computer data signal of Claim 67 wherein said manufacturing instructions comprise process sheets.

Claim 85.     The computer data signal of Claim 67 wherein said product drawings include an associative relationship with said master product and process concurrent model.

Claim 86.     The computer data signal of Claim 85 wherein said associative relationship is a parent/child relationship.

Claim 87.     The computer data signal of Claim 67 further comprising said master product and process concurrent model links to a process planning system.

Claim 88.     The computer data signal of Claim 87 wherein said process planning system comprises automated creation of a manufacturing process plan.